A NATIONAL AERONAUTICAL LABORATORY

BY A. F. ZAHM

THERE is in America a spontaneous movement, amply justified by present conditions, to marshal all our resources in aeronautics to the more systematic and scientific development of that fascinating, but as yet too deadly, mechanical art. For it is broadly appreciated that the adequate achievement of a system of locomotion so swift, so direct and universal, is abundantly worth the labor of a skilled army of men toiling unremittingly, if need be, through the entire twentieth century. And it is keenly realized that if this populous and wealthy nation, which has contributed nothing to the evolution of the buoyant air-ship, is to sustain in aviation a fair measure of the pre-eminence gained by her pioneers in aerodynamic research, and in the construction of aeroplanes and flying-boats, she must, even in these limited branches, wisely co-ordinate her best efforts and most effective agencies.

That pleasant pre-eminence has not only to be sustained; it has too patently, too largely to be retrieved. In aerodynamics our investigators once led the world; now, for want of endowment, they make only the feeblest progress. America produced the first steam and the first gasolene models capable of sustained flight; she invented and built the first passenger monoplanes and biplanes of adequate stability and power for prolonged voyages; yet to-day she stands before the world stripped of every first-class record coveted anywhere by the votaries of aviation. The records for speed, for distance, for altitude, for endurance, for swift climbing, for useful load, all have passed from the clever pioneer to the more systematic and zealous com-

petitor.* At the annual Olympic of aviation the grand trophy has been taken thrice consecutively by a French monoplane; and now the victor nation defies us to win back that coveted honor within three years' time by use of an American-built machine.

This very honorable challenge cannot, without deep humiliation, be ignored or lightly laughed away. We established that unique trophy, perhaps the most famous in tournamental history, and we also, in large measure, created the fantastic art of racing swallow-like through the fields of air. But this friendly appeal to our sportive and scientific skill is the least incentive to concerted action. Our own sense of the intrinsic value of aviation for civil use and for the national defense, and our native bent for hard and daring enterprise of epochal moment prompt us to the most virile effort and most rational co-ordination of forces. Our statesmen, therefore, and strategists, our opulent patrons of science, our engineers and constructors, our adroitest aviators, may well co-operate in the organized promotion of aeronautic science and art.

Of these various motives for solid team-work, the sportive one, though not less laudable than our ancient ardor to flag the poles, may be dismissed with kindly commendation. A lively emulation, however, in aeronautic science, a wise and sturdy strife for leadership, in the interest of human progress, cannot be too much encouraged in a huge commonwealth so beneficently dowered with the essential resources for advancing empiric knowledge. True, this is an appeal to sentiment. Our shrewd and practical opportunists advise delay till other nations shall have evolved an air-ship suitable for commercial exploitation. But is not this a trader's counsel which, if everywhere adopted, would stop the fundamental progress of the world? Fortunately the liberal and large American philanthropist is swayed not wholly by commercial predilections, and is no more keen to

* The present record for speed is 108¾ miles per hour in a closed circuit; for distance, 628 miles without stop; for altitude, 19,685 feet; for duration, 13 hours 18 minutes; for fast climbing nearly 500 feet per minute (1,640 feet in 3′ 35″); all records won by French pilots with French aeroplanes.

The most notable American record is that of Lieutenant John Towers in a Curtiss hydroaeroplane lasting 6 hours 10 minutes continuously. The 4,017 mile flight of C. P. Rodgers from New York to Pasadena was too broken and too protracted to have any technical significance.

foster the practical arts than to endow the basic sciences from which they spring.

If aeronautics could serve no other use than national protection its military value alone should claim our most careful attention. As an agency in strategic and tactical operations, not to mention the transportation of officers, troops, or supplies, it now ranks as the fourth arm of the greatest military establishments in the world. Already France's annual expenditure for this branch rapidly approximates the cost of a first-class battle-ship. And in this she is stoutly rivaled by Germany, and bravely emulated by Russia and Italy. Nor does there seem to be any hope of relief or escape from this new burden. On the contrary, in a contest of two well-matched powers command of the air may be but the prelude to domination by land or sea. No wonder the alert military states are diligently arming their avions and auto-balloons in anticipation of aggressive aerial warfare and of inevitable conflicts in the sky.

It is, however, the civil uses of aeronautics which may eventually far outvalue its military applications. Our present air craft have even now many of the essential qualities of a complete system of world navigation. In less than half a decade the auto-balloon has been transformed from a comparatively feeble and uncertain ship, battling its way against the wind, with all too frequent mishaps, into a powerful air liner carrying numerous passengers on schedule time. In Germany, Count Zeppelin's great rigid dirigible, the "Victoria Louise," launched in February, 1912, has been making regular voyages of ten to twenty hours, and carrying in snug accommodation upward of thirty passengers. These happy tourists, voyaging in stately splendor and admirable security, are borne through the sky at railway speeds, furnished with the finest parlor and café service of a modern palace-car. But these journeys form the merest beginning of a practical business in buoyant air navigation. The Zeppelin Company has been considering plans for a liner one thousand feet long, adapted to carry three hundred passengers at upward of fifty miles an hour, and competent to cross the Atlantic in three days. The famous inventor, Count Zeppelin, has made some calculations to prove that his passenger air-ships may be expected to pay good dividends in competition with established systems of trans-

portation. Nor is the Zeppelin Company the only one in Europe that operates a successful air-ship line.

The aeroplanes, too, despite their fatalities and transient loss of prestige, require little development, except in their engines, to adapt them to important industrial uses. A cheap-running reliable motor will enable them to compete for interurban traffic effectively with the automobile and the power-boat. In many respects they already equal or excel these popular vehicles of land and water. In their better types, they sweep from capital to capital with twice the speed of the eagle; they overtop the clouds and loftiest passes of Alps or Andes; they remain on the wing all day; they navigate in direct line over land and sea; over tracts impassable to any but aerial craft they carry the burden of an automobile with many times its average velocity. And in safety of transit may they not eventually surpass all the other high-speed contrivances known to man? At least this consummation is predicted by many inventors of first-rate ability.*

Prompted by the foregoing or like considerations, the friends of aeronautics in America are striving to secure for it a patronage and means of development commensurate with that which it enjoys in the great commonwealths of Europe. The Aero Club of America, with the indorsement of various scientific and technical organizations, has pledged itself to secure the endowment of a national aeronautical laboratory. The expediency of a broader and more generous encouragement of aerial navigation in all its branches, but especially as a means of national defense, has been favorably discussed in Congress preparatory to definite legislation. The aviation branches of the United States Army and Navy, though with limited resources, have been actively employed not only in training aviators, but also in testing the military value of

* Bleriot has expressed his conviction that the aeroplane will be generally adopted for moving swiftly and pleasantly from place to place, that it will be extremely safe, while swifter and cheaper than any other known vehicle of land or sea. "There is," he says, "absolutely nothing to prevent flight from becoming one of the greatest developments in the world's history."

At the Curtiss school during the past year a score to threescore flights have been made daily in all but the severest weather, and without serious accident. The running expense has been about the same as with an automobile of the same power.

the best available air craft and appliances. Their influence in bestirring manufacturers to meet more and more difficult requirements as to speed, endurance, climbing and carrying power, structural strength, efficiency, and whatever other qualities may be important in the military art, has been most beneficial. The final task, now fairly begun, is to coordinate these agencies by means of an organic general directorate, then to secure the requisite funds for the scientific and practical development of aeronautics in America. This financial assistance may be obtained either from Congress or by direct appeal to the people, as has been done so successfully in Europe; or through the munificence of zealous patrons who, emulating their sagacious peers in Russia, France, and Germany, may establish well-equipped laboratories for general service, and offer adequate remuneration or liberal awards for meritorious achievement in aero science or in the production or manipulation of aerial machines and appliances.

These separate phases of the general movement deserve more detailed exposition. But, for the presnt, only the effort to found a laboratory can have due consideration.

The national aerotechnical institution proposed by the Aero Club of America, and strongly advocated in its official bulletin, as in other progressive periodicals, is needed to furnish the basic facts and principles of aeronautic engineering, and such theoretic and empiric knowledge as may be useful to all promoters of the flying art. The inventors and builders in this country feel keenly the want of experimental data to form a rational basis for their structural designs; the users and students of air craft experience equally a want of adequate and disinterested tests of existing aeroplanes and their accessories.

The designing draughtsman poring over the plans for a novel flier, and loath to assign its shape and proportions by mere intuition or conjecture; the bewildered capitalist; the constructor and experimentalist disappointed in the output of their machine, designed without sufficient mechanical data; the Federal officers drawing specifications for requisite avions and searching in French, German, or Italian literature for information, charily disclosed, when not positively withheld, by foreign Governments, our aero clubmen, at great expense in time and money, striving with admirable sportsmanship and patriotism, by means of trophies, tourna-

ments, and cash awards, to improve all the important records of our aerial machines; the general public, horrified by the long list of avoidable fatalities due to inadequate provision for strength or stability—all have experienced the intense common desire for a more systematic and rational development of an art which can never be obliterated, but which, adequately developed and sensibly employed, may become a benefaction instead of a pernicious plague. There is, therefore, a general desire for an American institute that shall supply these wants in the broadest and most thorough manner, an institute not for training aviators or instructing engineers, for this is already done in several schools, but primarily for the increase and diffusion of aeronautical science. Only by means of such an establishment, and by the mutual aid and co-operation of all our votaries of the flying art, may we hope to keep pace with the progress, so conspicuous in foreign countries, in improving the security and capacity of aerial machines.

If the laboratory is to be broadly national it must subserve both civilian and military interests. If supported by Federal appropriations alone, it may be placed entirely in one of the regular bureaus of the Government; but if, like the National Museum, it is to be the recipient of private donations of equipment or money, it may very properly be made a branch of the Smithsonian Institution. This affiliation appeals to more than sentiment alone, however worthy; for the Smithsonian, besides its renown in aviation, already has a considerable nucleus of aeronautic apparatus, models, books, and so forth, and an endowment fund of one hundred thousand dollars for investigation of the properties of the air. But whether the laboratory be established by private means or governmental, or both, what our people require is a representative American institution in which a staff of trained specialists, provided with adequate apparatus, shall furnish physical constants, laws, formulæ, and empirical data of substantial and permanent value to the engineer, the inventor, and the manufacturer; a laboratory where complete and reliable tests and reports shall be made upon all classes of actual air craft that may be worthy of study and development; an institution surrounded by ample manœuvering space of land and water, and preferably adjacent to a governmental flying-ground, available with hangars and shops to all civilians worthy of assistance; a

center of scientific and practical activity, where at all times may be witnessed the most accurate researches and most exhaustive tests; where the knowledge so gained shall be disseminated by publications, by oral communications, by exhibitions of apparatus and instruments, of materials and models, by photographs and drawings—in a word, by all the facilities of the aerodrome, the showroom, the library, and the assembly-room.

This general conception of America's need in aerotechnical science has been for several years firmly maturing in the minds of all her votaries of aerial locomotion alert to the progress of this unique branch of engineering. Happily the general desire and the spontaneous movement for an adequate center of aerotechnical activity have been expressed in a specific working plan, submitted to his chief, by Captain W. I. Chambers, the officer in charge of aviation in the United States Navy. The approval and publication of this plan now brings before the American people a definite and practical ideal, of ample scope and liberality to serve both the needs of industrial and military aeronautics and the more rigorous demands of exact engineering science; an ideal that, less concretely, has been voiced many times in editorial comments, in the committees of aero clubs and scientific societies, and in the councils of various military and civil bureaus of the Federal Government. It is to be hoped, therefore, that the timely proposition of the Navy Department will, at least in its main features, meet with universal commendation and active support.

Captain Chambers proposes the establishment of a national aerodynamic laboratory having, besides many important concrete qualities, all the general characteristics hitherto set forth. He proposes that the laboratory shall be located in Washington and be so related to the Federal Government that it may receive Congressional appropriations together with private endowments, and that its directors may have important tests and investigations made at the various civil and military bureaus already possessed of equipment suitable for special aeronautic experiments. For example, the strength of materials can be measured at the Navy Yard; the properties of hydroplane floats or models can be studied at the Model Basin; detailed engine tests can be made at the Bureau of Standards; special meteorological investigations can be conducted at the Weather Bureau.

Still other physical and mechanical researches may well be carried on at universities and technical institutes in co-operation with the scientific staff of the national laboratory. But that important class of experimentation and study, for which we have at present no funds nor equipments, should be the peculiar task of the aerodynamical laboratory itself.

This establishment Captain Chambers proposes to place in the grounds of the Smithsonian Institution, where it may use the old shops and laboratories employed in Langley's aeronautic work, and may enjoy ready at hand many other facilities, such as offices, library, heat, light and power, a museum for models, an administrative force for receiving endowment funds and keeping accounts. A further reason for choosing this locality is that it is near to a large dead-level tract on the Potomac River front which, being Federal property, may be used for an aerodrome for land flights and manœuvers, while the river itself may serve for experimentation and practice with flying-boats. Hard by this fields are the Navy Yard shops, the Model Basin, three lofty open steel towers suitable for meteorological experiments, the Fort Myer garrison, the War College, and Washington Barracks where the Signal Corps has been instructing officers in the use of hydroaeroplanes. Finally the field, since it forms an undeveloped extension of the Monument Grounds and the Speedway, just below the White House, is most conveniently accessible to all the officers, both legislative and executive, of the National Government residing in Washington, who might well wish to witness aeroplane demonstrations and keep informed of the progress of civil and military aviation. Needless to add that the proposed tract is skirted by the railway and steamboat lines leading to the national capital. All in all, Captain Chambers considers that no more ideal location for an aeronautic laboratory and aerodrome exists anywhere in the world; ideal for both Federal and industrial activities; ideal for the Army, for the Navy, and, since Washington is a Mecca for business men, ideal for the convenience of the fabricator and seller of air craft, especially craft of the type designed for the use of the Government itself.

For the general supervision of the laboratory, Captain Chambers, having in view the efficient work of the British Advisory Committee for Aeronautics, proposes that, in addi-

tion to the director and his staff, there shall be a board, or council, empowered to outline the policies of the establishment, and broadly to initiate and review its activities, so as to provide most liberally and equitably for all the aeronautic interests of the nation. This council should not be a large body, but should comprise representative men, for the most part learned and technical; not indeed all specialists, but all interested in the sane development of aerial navigation; men of broad vision and experience whose presence shall guarantee fair treatment, as well to those who devise and manufacture aerial machines as to those who use them for any worthy end, whether of commerce, recreation, or military art. A special task of the council might well be to shield the scientific staff from the importunities and pressure of persons desiring to obtain, at the public expense, technical and laboratory aid in enterprises too purely private for the general interest, and for which nominal fees should be charged. Another function of the council, if in time it should become the recipient of suitable endowment funds, might be the offering of prizes and the granting of rewards for meritorious aeronautic achievements outside of the institution.

Summarizing the complete rôle of an ideal aerodynamic laboratory, Captain Chambers recognizes the following functions: "(1) Execution of verification tests by means of nominal fees; (2) facilities to technical men for prosecuting original researches; (3) execution of researches in accordance with a programme arranged by the council; and (4) reward for commendable results accomplished outside of the laboratory."

"Inasmuch," concludes his report, "as more definite information regarding the actual cost of a dignified and creditable, but modest and sufficient, installation should be obtained, and as the details of the plan, the scope, the organization, and the location of such an important undertaking should not be left to the recommendations of one man, *I respectfully recommend that a commission or board be appointed to consider and report to the President, for recommendation to Congress, the necessity or desirability for the establishment of a national aerodynamic laboratory, and on its scope, its organization, the most suitable location for it, and the cost of its installation.*"

The general plans for a national aerodynamic laboratory outlined by the Navy Department met with prompt recognition and distinguished favor. On December 19, 1912, the

President of the United States, acting on the recommendation of the Secretary of the Navy, made three days previously, created an Aeronautical Commission to report on the proposed laboratory, with a view to submitting a well-considered recommendation to Congress at an early date. Four statesmen and fifteen men of scientific training and experience were appointed on the Commission. Of the scientists and engineers all have been deeply interested in the progress of aeronautics; and the majority have made researches in aerodynamics or kindred branches. The membership represents widely different sections of the country and sufficiently diversified aeronautic interests.

If, after the report of this temporary body and the ensuing recommendation of the President, Congress shall create a permanent Aeronautic Commission charged with the duties of supervising the tests and researches of a national aeronautic laboratory and of allied establishments, it will be but following an excellent precedent. For nearly four years such a commission, known as the Advisory Committee for Aeronautics, has been actively at work in Great Britain. The renowned physicist, Lord Rayleigh, is its president. The other members, a dozen in all, include investigators in aerodynamics and cognate branches who have achieved world-wide distinction. And during the brief period of their labor they have amply justified the expectations of the people, and the hopes entertained by the Prime Minister of England in appointing the Committee. Nor is the work of this body at all unique. In France, in Germany, in Russia, in Italy, highly endowed aerotechnical institutes, both governmental and private, are vigorously prosecuting the greatest variety of investigations demanded by the constructional and military arts. These institutes have profoundly influenced the development of both branches of aerial locomotion. Though they cannot be described here, in closing, they may be said to have amply repaid the cost of their foundation and to warrant the establishment in America of an aeronautical laboratory which, in its directorate, its technical staff and its endowment, shall rank with the best in the world.

A. F. Zahm.